REMARKS

By this Amendment, claims 7-10 have been amended. Thus, claims 1-10 remain pending in the present application.

Applicant acknowledges with appreciation the Examiner's indication of allowable subject matter in dependent claim 7. Applicant submits, however, that claims 1-6 and 8-10 are also patentably distinguishable over the prior art of record, as explained below.

Claims 1, 2, 3, 4, 6 and 8 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Lin, U.S. Patent No. 6304,440 B1. Also, claims 5, 9 and 10 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of Lin, U.S. Patent No. 6,304,440 B1.

Lin issued as a patent on June 26, 2001, and can only be relied upon as prior art in the U.S. as far back as its U.S. filing date of August 18, 1999, which is after the June 24, 1999 filing date of Japanese Patent Application No. 11-177730, to which priority is claimed in the present application.

To eliminate Lin as prior art against the present application, therefore, Applicant submits herewith a verified translation of the priority document to thereby perfect the claim for priority.

Since Lin does not constitute prior art against the present application, withdrawal of the rejections is respectfully requested.

As all of pending claims 1-10 have been demonstrated to be allowable over the prior art of record, Applicant further submits that the present application is currently in condition for allowance. Early and favorable reconsideration in this regard is courteously solicited.

Dated: March 15, 2002

Respectfully submitted,

By _____

Steven I. Weisburd
Registration No.: 27,409
DICKSTEIN SHAPIRO MORIN &
OSHINSKY LLP
1177 Avenue of the Americas
41st Floor
New York, New York 10036-2714

#7 Sub Spec Markup

APPENDIX B

VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

PORTABLE INFORMATION RADIO TERMINAL DEVICE AND MANUFACTURING METHOD THEREOF

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates generally to a portable information radio terminal device or a personal digital assistance (PDA) and a manufacturing method thereof. More particularly, the invention relates to a portable information radio terminal device and a manufacturing method thereof, which can effectively prevent peeling off, breakage or so forth of electrical connecting portion of an electronic part mounted on a printed circuit board in a device casing.

Description of the Related Art

Conventionally, as shown in Figs. 3A and 3B, a printed board 12 incorporated in a portable information radio terminal device 11 is secured in a device casing by screws 15 and bosses 17. Accordingly, when an impact is exerted on the portable information radio terminal device 11, portions secured by the screws cannot ~~follow with vibration or deflection of the printed circuit board 12 caused by exertion of~~ the impact ~~to cause~~ stress concentration about the portions secured by the screws to amplify vibration or deflection of the printed board 12. As a result, peeling can be caused in solder ball (electrical connecting portion) of a chip size package (CSP) mounted on

the printed board 12.

In Japanese Unexamined Utility Model Publication No. Showa 58-162689, the following technology has been disclosed. Disclosed in the above-identified publication is a printed board support structure of an electronic equipment, in which a printed board mounting a printed wiring and various parts, such as relays and so forth, is rigidly fixed in a casing. Elastic engaging projections are projected from a printed board mounting surface of the casing. Also, an auxiliary projections are projected in opposition to the elastic engaging projections across the printed board with a distance. In the printed board, engaging holes to engage with the engaging projections are formed for forming the supporting structure of the printed board of the electronic equipment. On the other hand, between each of the supporting portions of the casing and the printed board, an elastic member, such as rubber member is disposed within a space portion for accommodating tolerance.

On the other hand, in Japanese Unexamined Patent Publication No. Heisei 8-23181, the following technology has been disclosed. A circuit board has a structure to be tightly clamped by first and second rollers. When the circuit board is inserted between the first and second rollers, the first and second rollers are rotated in a board inserting direction by a frictional force. With such construction, vibration to be caused in the equipment casing are absorbed to protect the

circuit board from vibration. Furthermore, the circuit board can be smoothly inserted into the casing.

It is desirable to maintain electrical connection of the electronic ~~pats~~ parts mounted on the board in the device body when the portable information ~~ratio~~ radio terminal device is subject to an impact (external force) due to ~~falling down~~ the device being dropped or so forth. It is also desired that large vibration(s) and/or impact ~~will~~ not be transmitted to the electronic parts within the device body to maintain electrical connection of the electronic parts and thus not ~~to~~ be a cause of failure of the electronic parts.

Also, it is desired to be able to easily produce the portable information radio terminal device to be resistant against ~~the~~ such an impact as set forth above.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a portable information radio terminal device or personal digital assistance (PDA) which can maintain electrical connection of electronic ~~pats~~ parts mounted on ~~the~~ a board in a device body when the portable information ~~ratio~~ radio terminal device is subject to an impact (external force) due to ~~falling~~ the device being dropped ~~down~~ or so forth.

Another object of the present invention is to provide a portable information radio terminal device, in which large vibration(s) and/or impact will not be transmitted to the electronic parts within the device body to maintain electrical

connection of the electronic parts and thus not ~~to be a~~ cause of failure of the electronic parts.

A further object of the present invention is to provide a manufacturing method to easily manufacture the portable information radio terminal device ~~to be~~ resistant against ~~the~~ impact ~~such an~~ as set forth above.

According to ~~the~~ a first aspect of the present invention, a portable information radio terminal device comprises:

a device body;

an electronic part provided in the device body; and

an elastic member supporting the electronic part within the device body.

According to ~~the~~ a second aspect of the present invention, a portable information radio terminal device comprises:

a device body;

a printed board provided in the device body;

an electronic part provided on the printed board; and

an elastic member supporting the printed board within the device body.

In the preferred construction, the device body may include a first and second casing to be assembled with each other, and the elastic member may be disposed between the printed board and the first casing and between the printed board and the second casing.

A direction of an elastic force acting on the printed

board from the elastic member disposed between the printed board and the first casing and a direction of an elastic force acting on the printed board from the elastic member disposed between the printed board and the second casing substantially may match with a direction of assembling the first and second casings.

The elastic body may be pressurized by assembling the first casing and the second casing. It is also possible that the elastic member is provided at only one side of the printed board in the longitudinal direction, and the other end side of the printed board in the longitudinal direction is situated as a free end.

The device body may be divided in its longitudinal direction into first and second halves, and the elastic member may be provided only on one of the first and second halves where a the gravity center of the portable information radio terminal device is located.

A plurality of elastic members may be provided per one side of the printed board.

According to the a third aspect of the present invention, a manufacturing method of a portable information radio terminal device for assembling a first casing and a second casing, and housing a printing -ed board between the first -st and second -s casing, comprises:

a step of arranging the printed board on one of the first and second casings via an elastic member; and

a step of assembling the other of the first and second casings to the one of the first and second casings with interpositioning the elastic member between the other of the first and second casings and the printed board.

Preferably, the first and second casings may be assembled with pressurizing the elastic member.

The portable information radio terminal device according to the present invention can reduce concentration of stress ~~to be~~ caused in response to an impact upon ~~falling down~~ dropping the device or so forth by holding the printed board assembled in the device body by the elastic member made with a material such as impact absorbing material having an high elastic force.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given hereinafter with reference to the accompanying drawings of the preferred embodiments of the present invention, which, however, should not be taken to be ~~limitative to~~ limiting of the present invention, but are provided for explanation and understanding only.

Figs. 1A and 1B show a first embodiment of a portable information radio terminal device according to the present invention, in which Fig. 1A is a front elevational view, and Fig. 1B is a cross-sectional view taken along line A - A of Fig. 1A;

Fig. 2 is a front elevational view of a printed board and an elastic body of a second embodiment of a portable information

radio terminal device according to the present invention; and

Figs. 3A and 3B show ~~the~~ a conventional portable information radio terminal device ~~according to the present invention~~, in which Fig. 3A is a front elevational view thereof, and Fig. 3B is a cross-sectional view taken along line B - B of Fig. 3A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be discussed hereinafter in detail in terms of the preferred embodiments of the present invention with reference to the accompanying drawings. In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be obvious, however, to those skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known structures are not shown in detail in order to avoid unnecessarily obscuring the present invention.

Figs. 1A and 1B show ~~the~~ a first embodiment of a portable information radio terminal device according to the present invention, in which Fig. 1A is a front elevational view, and Fig. 1B is a cross-sectional view taken along line A - A of Fig. 1A. As shown in Figs. 1A and 1B, a portable information ratio terminal device 1 has a receiver portion 1a, a transmitter portion 1b, a liquid crystal display portion 1c and an operation portion 1d. A printed board 2 assembled with a device body 1H is held through an elastic member 5.

As shown in Fig. 1B, the elastic member 5 is tightly fitted between an upper casing 3 and the printed board 2 and between a lower casing 4 and the printed board 2 without any gaps under a slightly pressurized condition. If a gap is present, impact absorbing ability and stress distribution performance may be lowered.

When the portable information radio terminal device 1 is subjected to an impact due to the device being dropped or some other reason, a phenomenon occurs in which large vibrations and deflections of the upper casing 3, the lower casing 4 and the printed board 2 assembled in the device body 1H are caused. At this time, vibration and deflection between the upper casing 3 and the printed board 2 and between the lower casing 4 and the printed board 4 are absorbed by the elastic member 5. Also, since the printed board is bonded to the elastic member 5 at only a single point and the elastic member 5 does not fix the printed board to prevent vibration or deflection, stress concentration can be avoided. Accordingly, the effects of large vibrations on the printer board per se can be reduced. By this, CPSs mounted on the printed board are less likely to peel off the printed board 2.

As shown in Fig. 1B, the printed board 2 has a longitudinal length of about half of that of the device body 1H and is arranged at approximately the upper half in the longitudinal direction of the device body 1H. On a surface of the printed board 2 opposing to an inner surface of the lower

casing 4, electronic parts such as CSPs (Chip Size Packages) are mounted.

Among the components in the portable information radio terminal device 1, ~~a weight of~~ the liquid crystal display portion 1c ~~becomes~~ is relatively ~~large which can be~~ heavy and constitutes a large proportion ~~in a~~ of the overall weight of the portable information radio terminal device 1. As shown in Fig. 1A, since the liquid crystal display portion 1c is located ~~at~~ in the upper ~~side of~~ half in the longitudinal direction of the device body 1H, ~~a~~ the center of gravity ~~center~~ of the portable information radio terminal device 1 is located at the upper side of the center portion in the longitudinal direction. Accordingly, when the portable information radio terminal device 1 ~~falls down~~ is dropped, it inherently fall in ~~the~~ an upside-down ~~attitude collide at~~ orientation such that the upper side ~~to easily subject~~ is most likely to suffer ~~to~~ the impact of the collision. For this reason, in order to ~~obtain~~ achieve efficient impact resistance, ~~a portion holding~~ the printed board 2 ~~on~~ is held in the device body 1H ~~with~~ by the elastic member 5 ~~is set~~ positioned at the upper side in the longitudinal direction of the portable information radio terminal device 1 and in the vicinity of the uppermost position of the printed board 2.

The printed board 2 is supported only on the side close to the uppermost position thereof to thereby situate the other end of the printed board 2 in the longitudinal dir ction as a free end. This works together with the elasticity of the supporting portion (elastic member 5) of the printed board 2 to provide an ~~cause~~ appropriate

degree of elastic deformation in the printed board 2 without causing local stress concentration when an external force is applied to the portable information radio terminal device 1, thereby to cancel energy of the external force acting on the printed board 2. Accordingly, stress concentration will not be caused in the electrical connecting portion of the CSP 6 on the printed board 2 or the CSP per se.

A contact area of the elastic member 5 with the printed board 2 and a contact area of the elastic member 5 with the upper casing 3 or the lower casing 4 are substantially the same size as each other. The contact area is desired to be as large as possible. By providing a large area for supporting the printed board 2 by the elastic member 5, stress is not concentrated when the portable information radio terminal device 1 is subjected to an impact to prevent the printed board from vibrating or deflecting.

As set forth above, the elastic member 5 supporting the printed board 2 abuts with the upper casing 3 and the lower casing 4 of the device body 1H. When the portable information radio terminal device 1 is ~~fallen down~~ dropped, it tends to fall down to ~~abut onto~~ hit the ground ~~from~~ either at the upper surface of the upper casing 3 ~~to be an~~ which is the operation surface and a display surface or ~~from a~~ at the back surface of the lower casing 4 located on the back side ~~to easily cause impact~~ of the device. ~~Associating with this~~ Accordingly, the elastic body 5 abuts on the surfaces extending in ~~surface~~ a

direction of the upper surface and the back surface of the device body 1H ~~in order~~ to enhance its impact absorbing ability.

Bonding of the elastic member 5 onto the printed board 2 and the upper and lower casings 3 and 4 may be achieved using ~~is done by~~ various types of adhesive. In this case, corresponding to a bonding force applied by the adhesive per se, a clamping force may be exerted to depress the elastic member 5 onto the printed board 2 from the upper and lower casings 3 and 4 ~~may act~~.

The material and elastic modules of the elastic member 5 are selected for effectively absorbing an impact to be exerted onto the portable information radio terminal device 1 upon ~~fallen~~ falling down from a height ~~supposed in~~ during a normal use condition, and to effectively prevent failure of the electronic parts and/or peeling off of the connecting portion.

In the embodiment shown in Fig. 1(b), the elastic member 5 is arranged both between the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4. In the shown embodiment, the elastic member 5 is ~~consisted~~ composed of mutually separate elastic components respectively disposed between the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4. However, instead of forming the elastic member 5 with separated two elastic components, it is possible to form it with a single elastic component with a cut out portion for receiving the printed board 2 therein.

Upon supporting the printed board 2 by an elastic force of the elastic member 5, ~~a~~ the direction ~~to apply~~ in which the elastic force is applied onto the printed board 2 matches with a direction ~~to mating and assembling~~ in which the upper casing 3 and the lower casing 4 are mated and assembled upon manufacturing of the portable information radio terminal device 1 (horizontal direction in Fig. 1B). Accordingly, upon manufacturing of the portable information radio terminal device 1, in the condition where the printed board 2 is placed at a predetermined position on the inner surface of one of the upper casing 3 and the lower casing 4 via the elastic member 5, the other of the upper casing 3 and the lower casing 4 is fitted via the elastic member 5 arranged on the inner surface. By this process, the elastic member 5 is properly pressurized ~~with each other~~ with respect to the upper casing 3, the lower casing 4 and the printed board 2. In this case, between the upper casing 3 and the lower casing 4 which are preliminarily molded into predetermined shapes, respectively, the elastic member 5 is disposed to adjust the elastic force of the elastic member 5 acting on the printed board 2 automatically and optimally. This can be achieved either in the case where the elastic member 5 is formed ~~with~~ as separated two elastic components or in the case where the elastic member 5 is formed ~~with~~ as one elastic component having a ~~member with the~~ cut out portion.

On the other hand, while not illustrated in the drawings, the elastic member 5 can be provided only on one side between

the printed board 2 and the upper casing 3 and between the printed board 2 and the lower casing 4.

Also, the printed board 2 is supported in a cantilever arrangement in which it is supported only at one end portion thereof in the longitudinal direction of the printed board 2 (but is supported along a wide contact surface) in the shown embodiment. However, it is also possible to support the elastic member 5 at both ends in the longitudinal direction.

Next, a second embodiment of the present invention will be discussed with reference to Fig. 2.

As shown in Fig. 2, the elastic members 5 are arranged in the vicinity of the CSPs 6 mounted on the printed board 2 and are bonded at a plurality of positioned on the printed board 2. Among a plurality of elastic members 5, some of the elastic members 5 are arranged on both end portions in the longitudinal direction of the printed board 2. The other part of the elastic members 5 are arranged in extension along the outer edge portion of the substantially quadrangular shaped CSPs 6.

In the embodiment shown in Fig. 2, a ratio of total contact area of a plurality of (five in the embodiment shown in Fig. 2) of elastic members 5 provided on the surface 2a and the surface 2a versus the area of the surface 2a on the side of the printed board where the CSPs 6 are mounted, is about 7.5%. It is also desirable to bond a plurality of elastic members 5 even on the back surface of the surface 2a of the printed

board 2. ~~In view of~~ To achieve effective stress distribution or impact absorption, it is desirable to bond the elastic members 5 on the back sides of the printed board in a ratio of area greater than or equal to 5%. Furthermore, the elastic members 5 provided at a plurality of positions on both ~~of~~ the front surface and back sides of the printed board 2 can be provided at corresponding positions of the front surface side and the back side, respectively. In the alternative, it is also possible to provide the elastic members 5 at mutually offset positions on the surface side and the back side of the printed board 2.

In the shown embodiment of the portable information radio terminal device 1, by holding the printed board 2 assembled in the device body 1 with the elastic members 5 made of impact absorbing material, ~~it can prevent~~ solder balls of the CSPs and the like mounted on the printed board 2 can be prevented from breaking or peeling due to vibration or deflection of the printed board 2 in response to ~~exertion~~ the force of ~~the~~ an impact caused by the device being dropped ~~falling down~~ or other reason.

In particular, in the embodiment shown in Figs. 1A and 1B, the printed board ~~21~~ 2 assembled in the portable information radio terminal device 1 is held by the elastic member 5, made of a material such as an impact absorbing material, ~~disposed~~ between the upper casing 3 and the lower casing 4. By this arrangement, ~~the~~ stress ~~to be~~ exerted upon receiving an impact due to the device being dropped ~~falling down~~ any or so forth, will not be concentrated ~~to the one~~ at a fixed point and be distributed

to prevent the printed board 2 from causing significant vibration or deflection. Furthermore, as shown in Fig. 2, the effect can be further enhanced by bonding the elastic members 5 to a plurality of ~~portions~~ locations.

It should be noted that while the shown embodiments ~~take~~ are ~~constructions~~ constructed to support the printed board 2 by the elastic member or members 5 disposed between the upper casing and the printed board 2 and/or between the lower casing and the printed board 2, the present invention should not be limited to a construction where the printed board 2 is supported only by the elastic member or members 5. When an external force, such as ~~an~~ an impact upon ~~falling down~~ being dropped or the like, is exerted on the portable information radio terminal device 1, the printed board 2 is supported at a plurality of positions or with a relatively large area or at a displaceable point so as to distribute the stress to a plurality of positions or to a wide region in order to avoid stress concentration ~~to~~ at one ~~position~~ location. Therefore, stress can be distributed.

With the embodiments set forth above, one effect is to solve the problem of breakage or peeling off of the CSPs mounted on the board. Therefore, ~~an~~ the influence of ~~falling down~~ an impact ~~of a~~ from dropping the portable telephone can be reduced. The reason is that, by holding the printed board with the elastic member without using ~~screws~~ any screw, a portion supporting the printed board becomes wider to avoid concentration of the stress upon exertion of ~~an~~ an impact,

by dropping the device

such as ~~falling down~~, to prevent vibration or deflection of the printed board.

It should be noted that what is supported by the elastic member is not limited to the printed board but can be various other boards on which ~~mounting the~~ electronic parts are mounted, or can be an electronic part per se.

With the portable information radio terminal device according to the present invention, electrical connection of the electronic parts mounted on the board in the device body can be maintained even upon exertion of an impact (external force) due to dropping of the portable information radio terminal device to minimize the possibility of an occurrence of failure of the electronic parts.

Although the present invention has been illustrated and described with respect to exemplary embodiments thereof, it should be understood by those skilled in the art that the foregoing and various changes, omission, and additions may be made therein and thereto, without departing from the spirit and scope of the present invention. Therefore, the present invention should not be understood as limited to the specific embodiment described above but to include all possible embodiments which can be embodied within the scope encompassed by and equivalent thereof with respect to the feature set forth in the appended claims.

APPENDIX B

VERSION WITH MARKINGS TO SHOW CHANGES MADE
37 C.F.R. § 1.121(b)(ii) AND (c)(i)

SPECIFICATION:

Attached hereto is a marked copy of the original specification showing the changes made.

CLAIMS:

7. (Amended) A portable information radio terminal device as set forth in claim 1, wherein said device body is divided in the longitudinal direction into first and second halves, and said elastic member is provided only on one of said first and second halves where a center [gravity] of gravity of said portable information radio terminal device is located.

8. (Amended) A portable information radio terminal device as set forth in claim 2, wherein a plurality of elastic members are provided per [one] side of said printed board.

9. (Amended) A [manufacturing] method of manufacturing a portable information radio terminal device for assembling a first casing and a second casing, and housing a [printing] printed board between said [fir] first and second [casing] casings, comprising:

a step of arranging said printed board on one of said first and second casings [via] with an elastic member positioned between said printed board and said one of said first and second casings to support said printed board; and

a step of assembling the other of said first and second casings to said one of said first and second [casing with] casings while interpositioning said elastic member between said [the] other of said first and second casings and said printed board.

10. (Amended) A [manufacturing] method of manufacturing a portable information radio terminal device as set forth in claim 9, wherein said elastic member is pressurized upon assembling said first and second casings [are assembled with pressurizing said elastic member].